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DTE Methane Resources

U.S. EPA Coalbed Methane Outreach Program

Case Study: Long Term Abandoned Mine Methane Recovery Operation in the U.S.

Methane to Markets Partnership-wide and Steering Committee Meeting, Monterrey, Mexico

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Presented by:

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Presentation Outline

- Project Background
- Field Operations
- Project Performance
- Estimating Reserves
- Lesson's learned

Project Background

- First started by Illinois Methane in 2002 and was shutdown for financial reasons in 2004
- DTE Methane Resources purchased from Illinois Methane in 2004, modified the facilities, and restarted the project in March 2005

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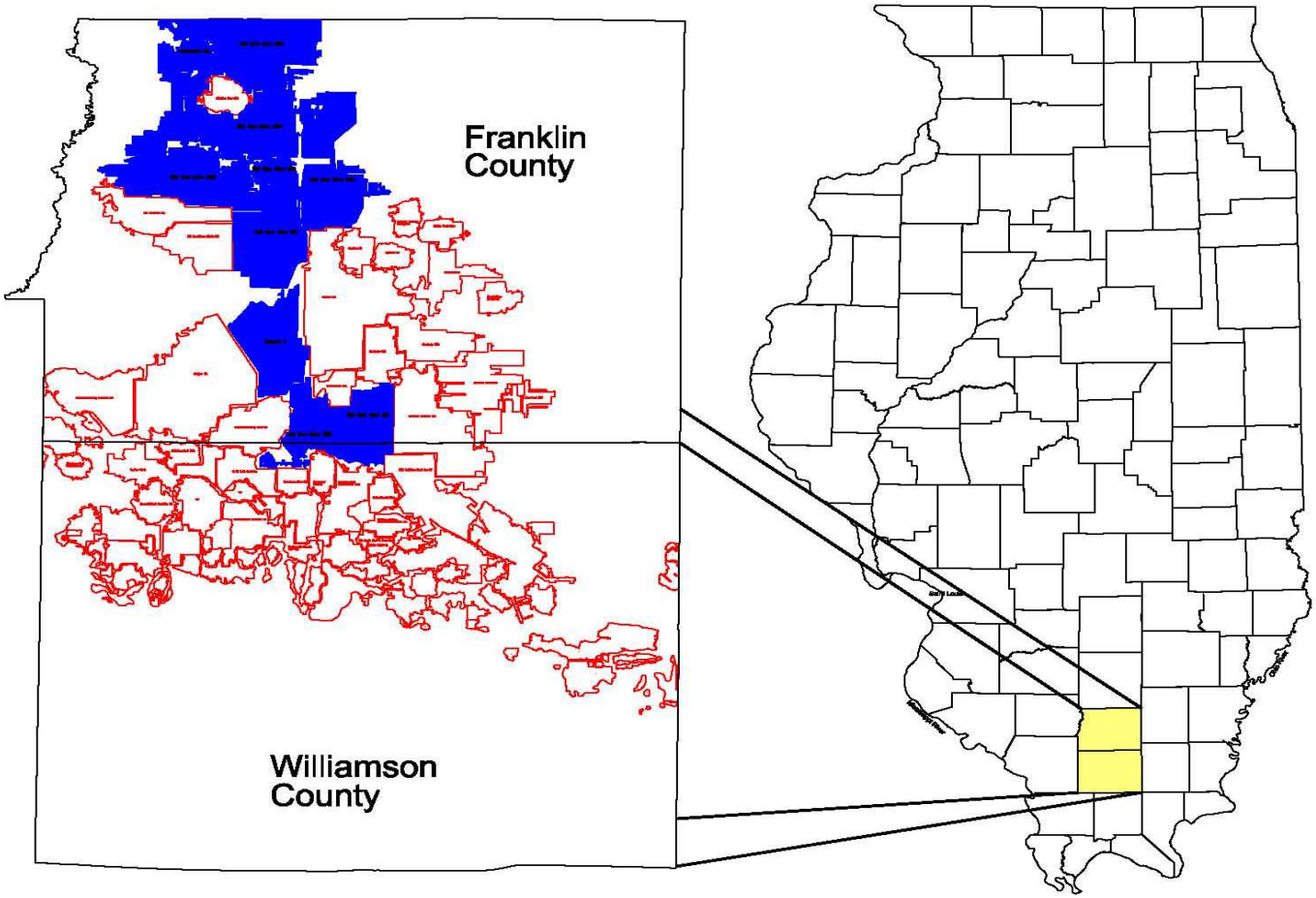
Project Background



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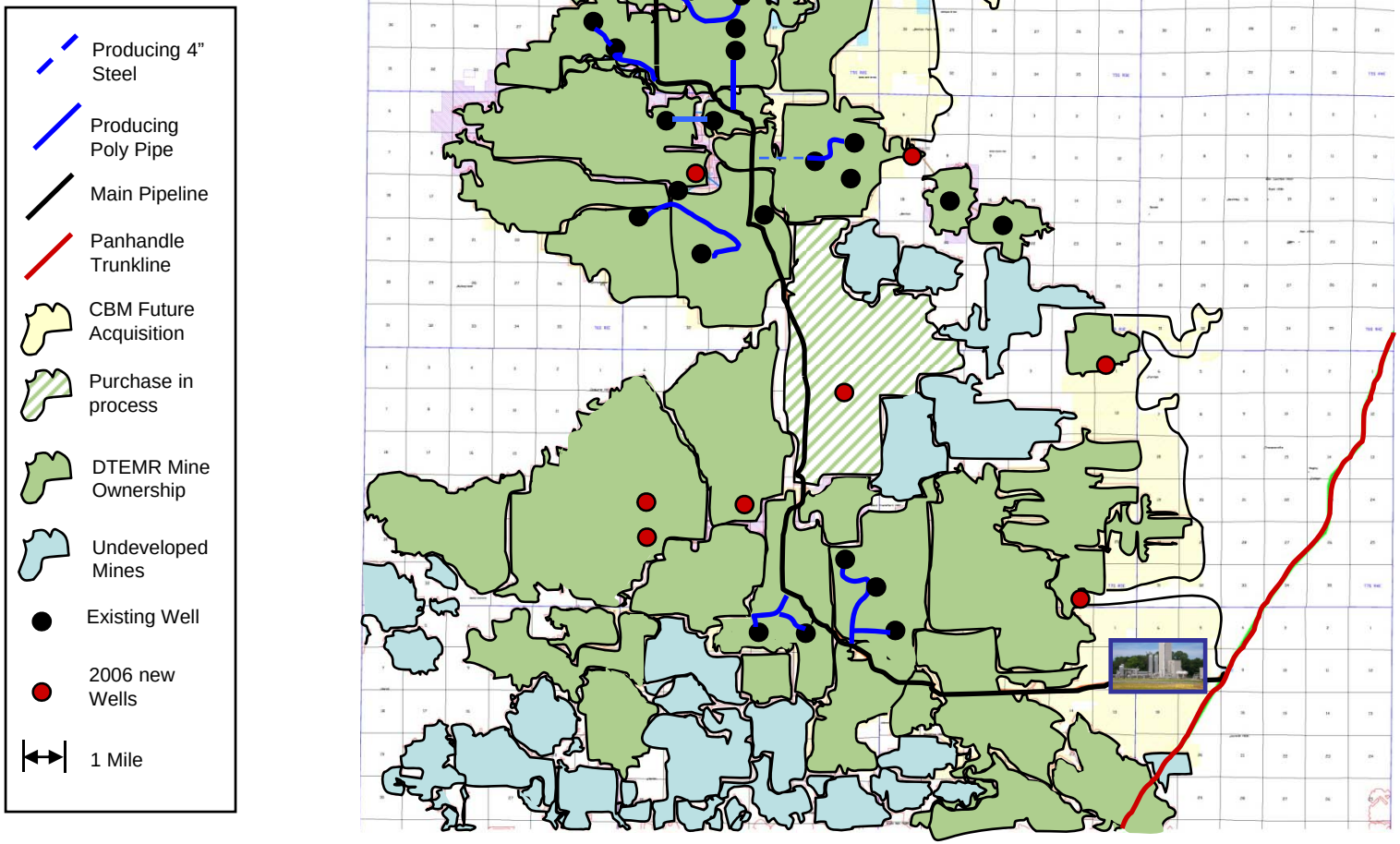
83,000 acres

34 wells



Project Background

- The Mines
  - The mines in the project range in depth from approximately 100 to 200 meters.
  - All project mines are shaft mines and most are tightly sealed from the atmosphere.
  - Mine abandonment dates range from 1926 to 1996.

Project Background

- The Mines
  - The average gas composition is 72% methane, 20% nitrogen and 8% carbon dioxide.
  - The pressure in the mines prior to production ranged from 6.9 kpa to 106.2 kpa above atmospheric (1 psig to 15.4 psig) averaging 71.7 kpa (10.4 psig).
  - The average mined coal seam thickness is 2.5 meters (8.3 feet)
  - Some mines were found to be in pressure communication with each other

Project Background

- Risks
  - Mines are water flooded.
  - Low pressure (leakage or historical venting).
  - Well location (roof collapse or tight seals).
  - Air inflow (quality issue).
  - Recharge rate of methane limits production rate.
  - Drilling into coal pillars.

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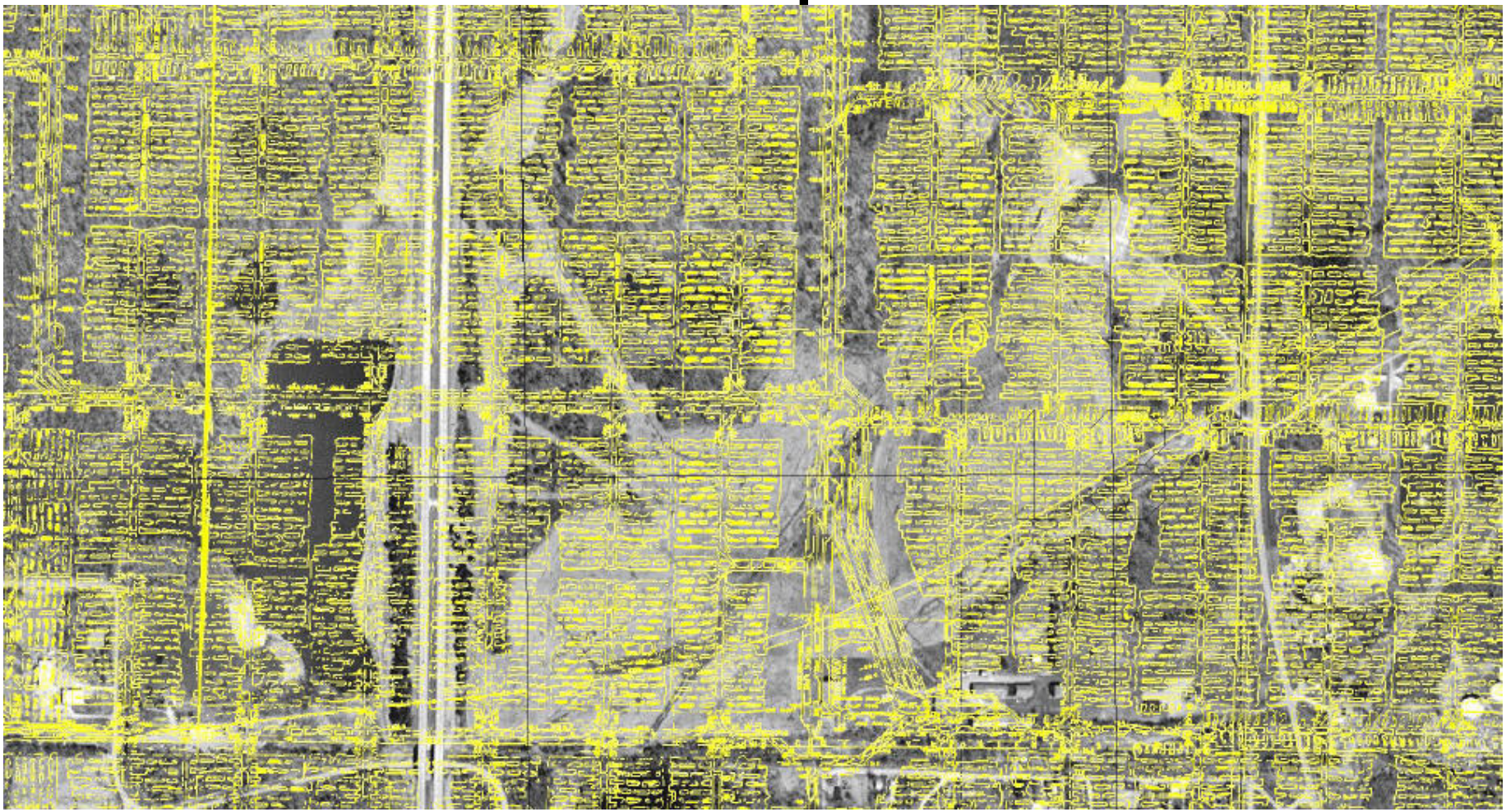
Arial Photo Overlay on Mine Map



Operations: Wells

- Metering runs consist of either venturi tubes or orifice runs
- Meters are read monthly
- Quarterly calibration checks
- Quarterly gas sampling
- Well headers to field stations are HDPE

Operations: Wells

- Drilled using truck-mounted rigs commonly used for coring of coal exploration wells
- Blowout preventers are necessary
- Casing program
  - 8-5/8” surface casing
  - 5-1/2” production casing cemented to surface
  - Case to within 50 feet of mine void
- Drill into mine with a 4-3/4” bit

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Operations: Wells

Operations: Field Compressor Stations

- Wells connected to individual field stations via HDPE pipelines
- Standard infrastructure at each field station includes suction scrubber, compressor-gas engine skid, discharge scrubber, and metering
- Compression equipment comprises oil-flooded rotary screw compressors driven by gas engines operating on coal mine methane

Operations: Field Compressor Stations

- Gas compression capacities vary from 0.1MMSCFD to 1.7MMSCFD (40 to 400 BHP); six stations total
- Nominal design compressor operating range is -3 psig intake up to 170 psig discharge pressures
- Two full-time field operators
- Gas accumulator bottles are installed to obtain a weighted average gas composition

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Field Compressor Station

Operations: Gathering Pipeline

- Twenty-nine (29) miles of 8-inch diameter carbon steel, internally coated pipeline
- Maximum operating pressure of 720 psig
- Capacity up to 14 MMSCFD
- Typical operating pressures range from 130 to 140 psig at the beginning of the pipeline to about 90 psig at the processing plant
- Quarterly Batch inhibition schedule for corrosion protection

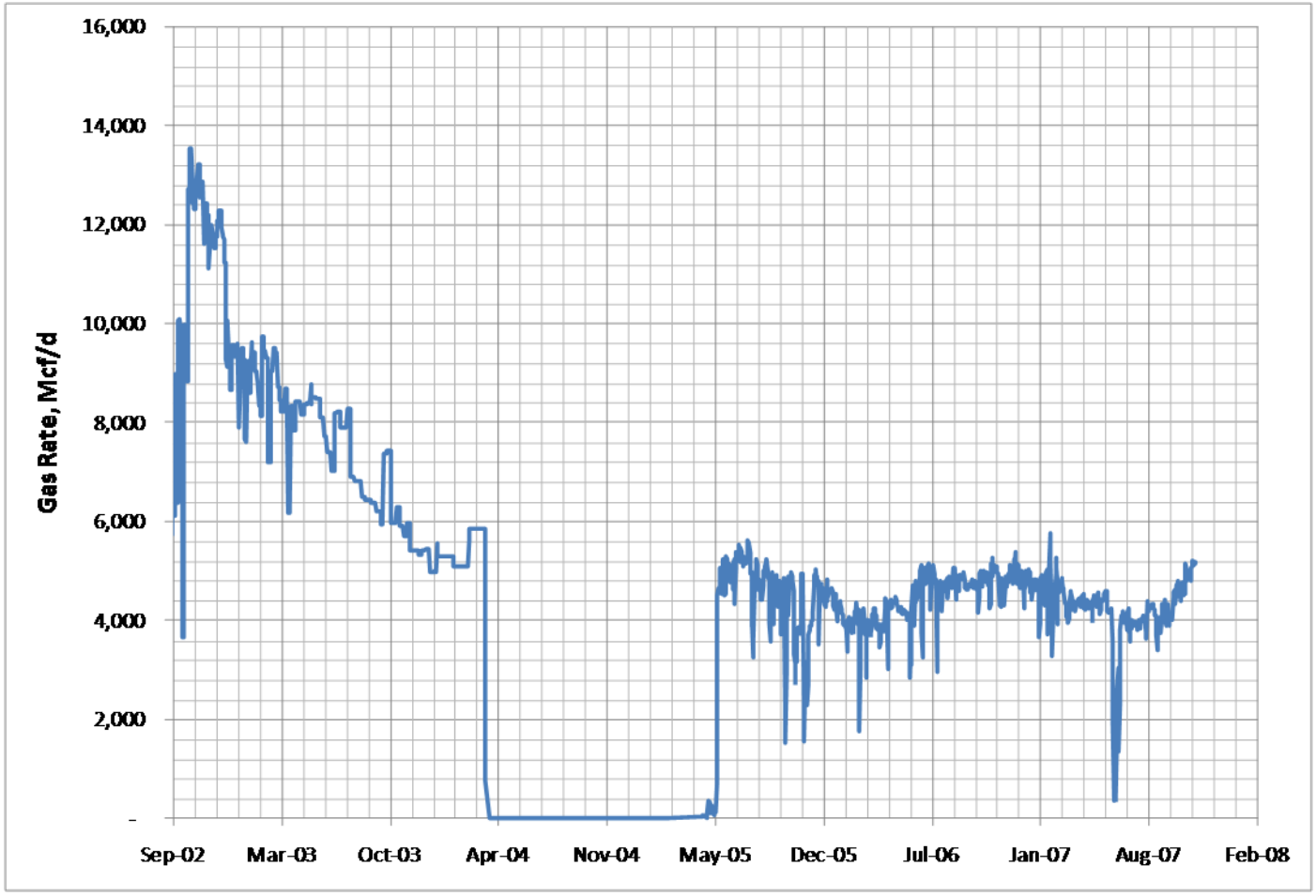
Operations: Gas Processing Plant

- Inlet Gas Quality
  - Methane: 74%
  - Nitrogen: 18%
  - Carbon Dioxide: 8%
  - Oxygen: 0.1%
  - Hydrogen Sulfide: Trace to 5 ppmv
  - Heating Value (HHV): 750 Btu/scf

Operations: Gas Processing Plant

- Inlet Gas Volumes
  - Design: 12.5 MMSCFD
  - Current Rates: 4 to 6 MMSCFD
- Plant Design & Construction
  - BCCK Engineering (Midland, TX)
- Four full-time Operators (24/7 coverage)
- One full-time Facility Manager

Project Performance



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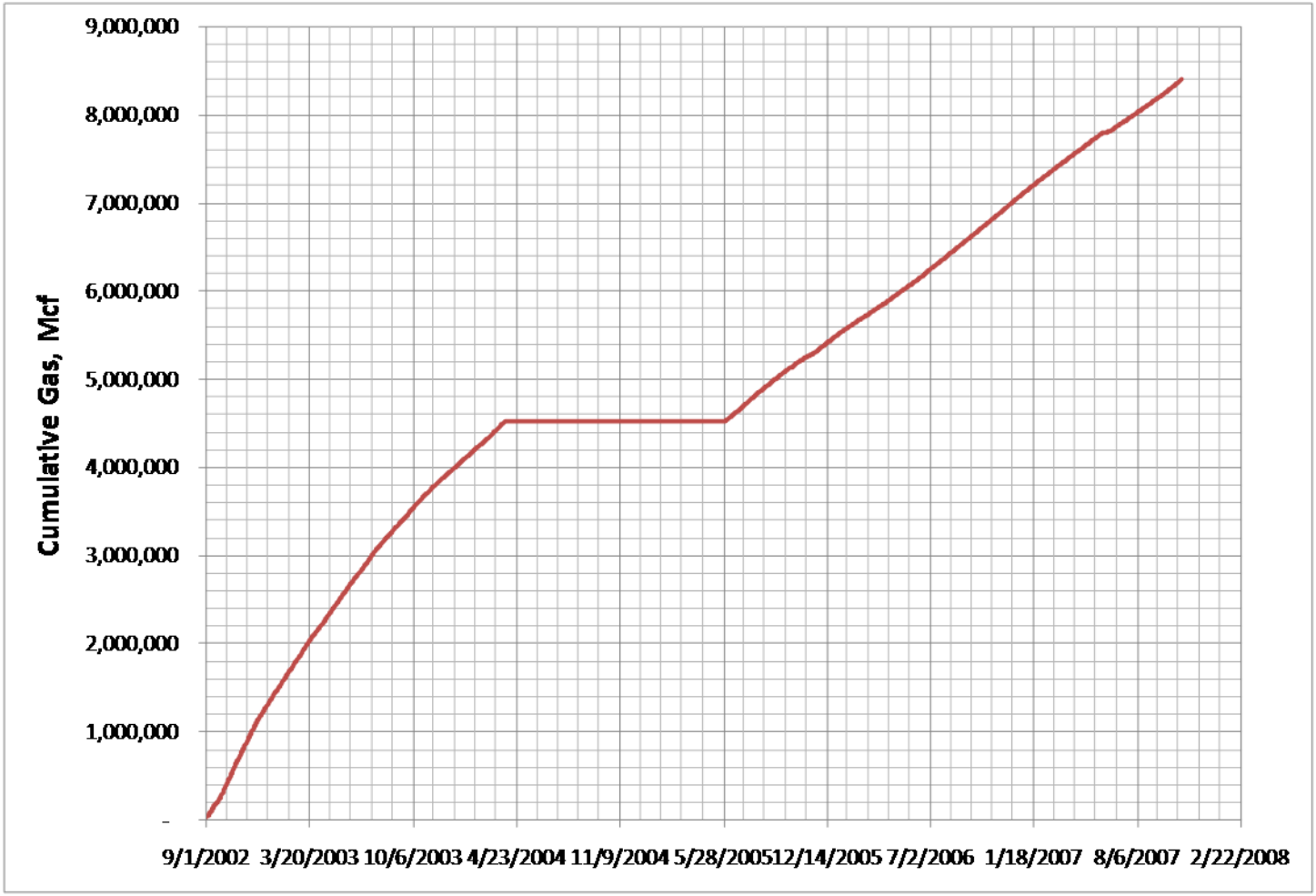
Project Performance



Estimating Reserves

- Build a conceptual numerical model for Computational Fluid Dynamics simulation for each mine.
- Each model is based on:
  - Known information
  - Estimated information

Known Information

- Pressure in the void area
- Mine size
- Gas production and pressure history

Estimated information

- Volume of coal in contact with void based on stratigraphic column
- Permeability of coal and void
- Adsorption isotherm
- Sorption time
- Initial assumption that the mine is not flooded

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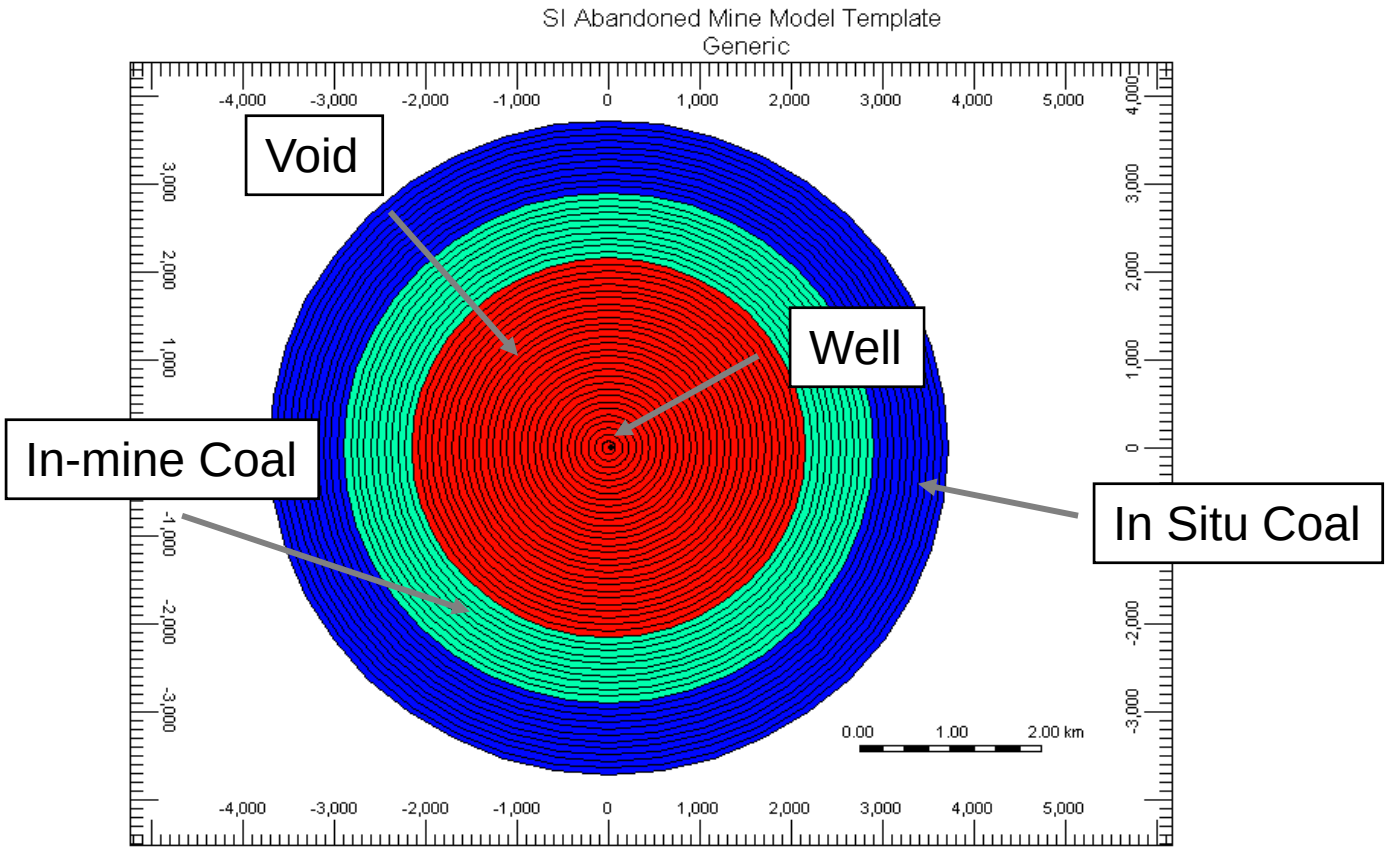
Areal View of a Conceptual Abandoned Mine Model



Estimating Reserves

- Model calibration
  - The model's gas production rate is forced to match actual data.
  - Flowing wellhead pressure is predicted by the model
  - The model's permeability and volume parameters are modified within limits to match measured wellhead pressure data

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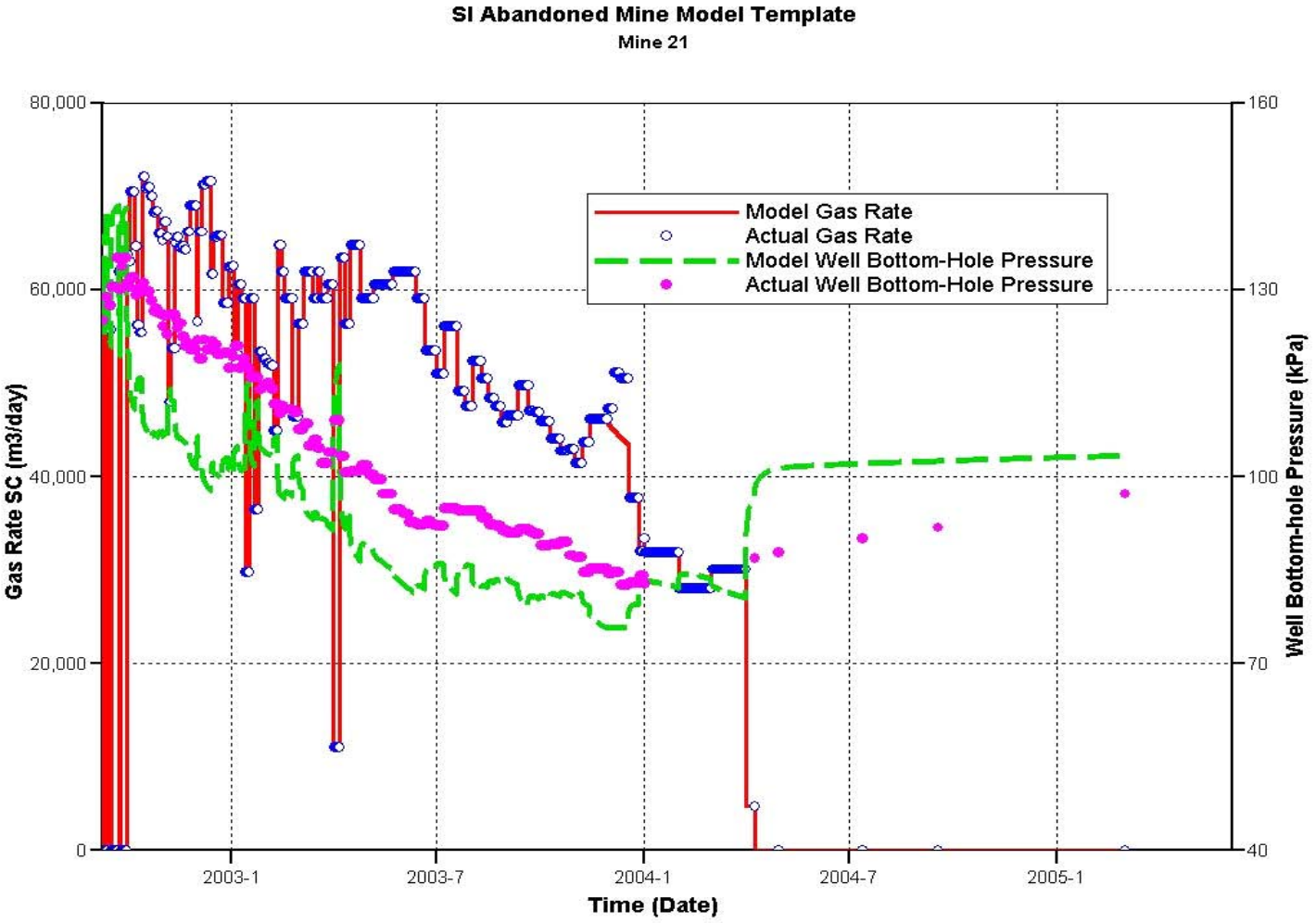
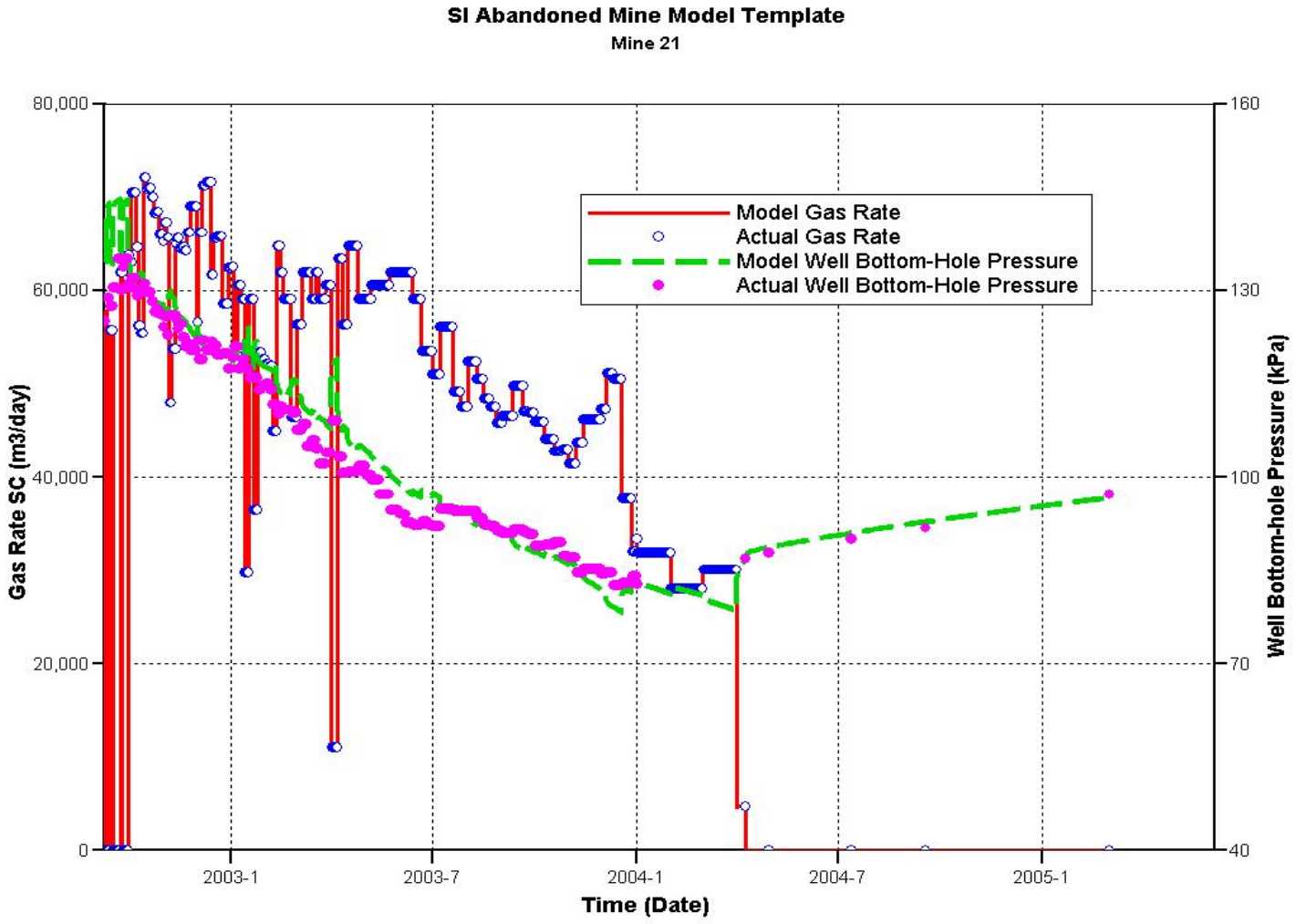
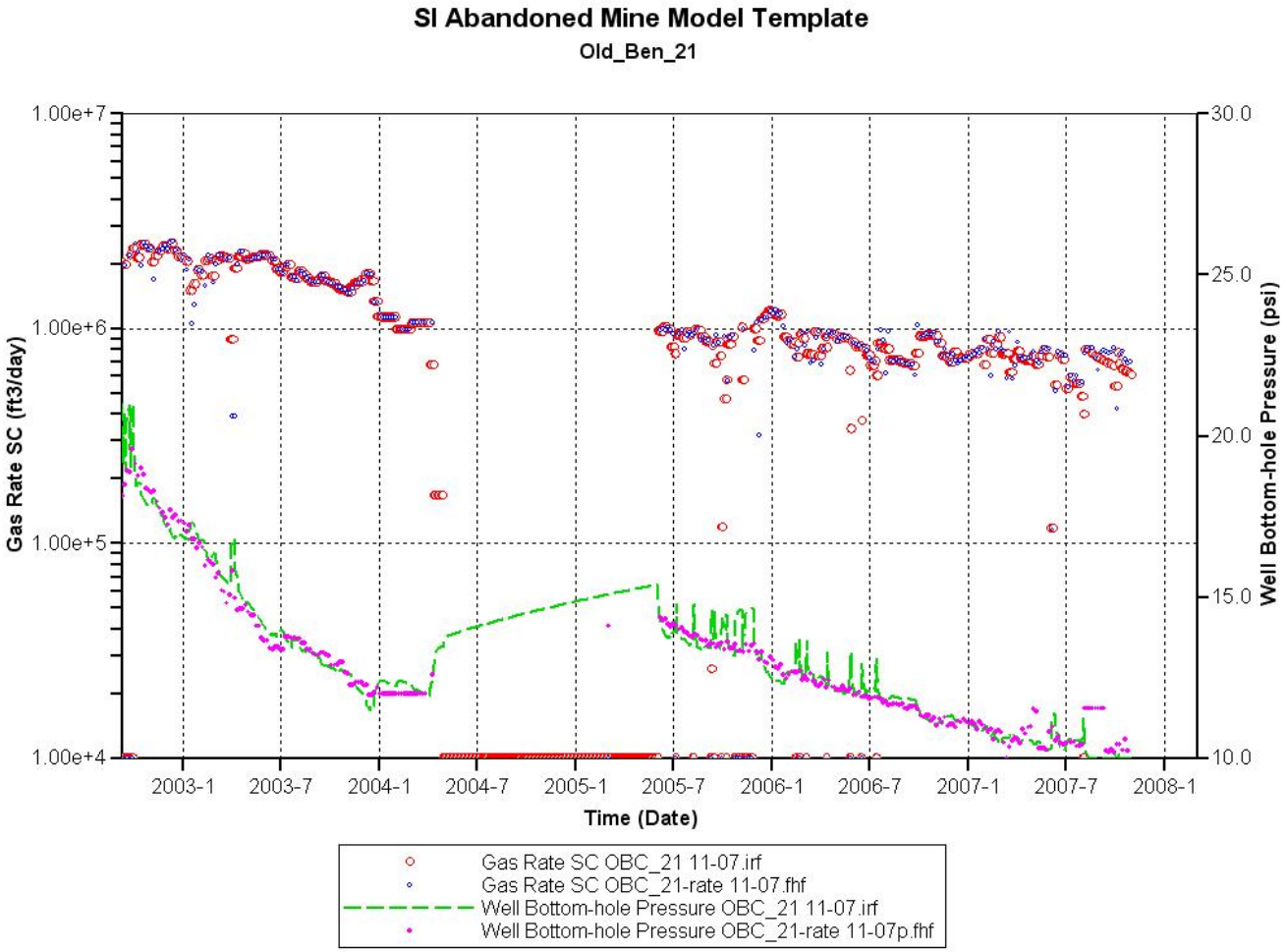
Initial Pressure Match



Final Pressure Match



History Match After 5 Years



Expected Ultimate Recovery, Mcf

	Jan 06	Oct 07
OBC #8	1,084,000	940,982
OBC #14	1,891,200	2,436,243
OBC #15	472,390	378,499
OBC #19	256,670	217,552
OBC #21	2,973,300	2,490,489
OBC #22	1,717,400	1,340,187
OBC #24	2,587,000	2,356,221
OBC #26	3,301,700	3,605,208
Orient #1	-	741,098
Total	14,283,660	14,506,480

Lessons Learned

- Adequate resource evaluation is essential to avoid over-sizing facilities
- All gas processing technologies should be considered
- Monitoring production volumes, wellhead pressures and gas composition is essential for reserves analysis

Lessons Learned

- Reservoir models need to be updated periodically to adequately account for long-term recharge rates
- Well location selection requires detailed evaluation of mine maps
- Performance risk based on flooding and/or compartmentalization needs to be taken into account

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Thank you

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History Matching the Measured BHP by Varying the Permeability